



WHAT IS CLAIMED IS:

Sub A

1. A method for forming a shallow trench isolation structure, comprising the steps of:

providing a substrate comprising at least a trench and an active region covered 5 by a mask layer and isolated by the trench;

forming an insulation layer to fill the trenches and to cover the mask layer by high density plasma chemical vapor deposition, wherein a surface of the insulation layer is higher than a surface of the substrate and lower than a surface of the mask layer;

forming a thin film on the insulation layer;

10 forming a screen layer on the thin film by a fluid precursor;

removing the screen layer and the thin film over the active region, while the screen layer and the thin film above the trenches are not removed;

removing the insulating layer above the active areas to expose the mask layer;

removing the screen layer to expose the thin film in the trench;

15 removing the thin film above the trench to expose the insulation layer; and

removing the mask layer above the active region.

2. The method of claim 1, wherein the insulating layer includes a silicon oxide layer.

20 3. The method of claim 1, wherein the thin film includes a silicon nitride layer.

4. The method of claim 1, wherein the thin film includes a polysilicon layer.

5. The method of claim 1, wherein the screen layer includes a spin-on-glass

layer.

6. The method of claim 1, wherein the screen layer includes a photoresist layer.

5 7. The method of claim 1, comprising further a step of forming a pad oxide layer on the substrate under the mask layer.

10 8. A method for forming a shallow trench isolation structure, comprising: providing a substrate comprising a plurality of trenches and a plurality of active areas, wherein the active areas are covered by a pad oxide layer and a mask layer;

15 forming an insulation layer in the trenches and on the mask layer, wherein the insulation layer in the trenches has a surface higher than a surface of the substrate and lower than a surface of the mask layer, and wherein the insulation layer on the mask layer has vertical sidewalls;

20 forming a thin film on the insulation layer above the active areas and the trenches, wherein the thin film formed on the vertical sidewalls of the insulation layer is thinner than the thin film formed on other positions of the insulation layer;

25 forming a screen layer on the thin film by a fluid precursor, wherein a thickness of the screen layer formed above the active areas is thinner than a thickness of the screen layer formed above the trenches;

30 removing the screen layer and the thin film above the active areas, while the screen layer and the thin film above the trenches are not removed;

35 removing the insulating layer above the active areas;

40 removing the screen layer above the trenches;

~~removing the thin film above the trenches; and
removing the mask layer above the active areas.~~

9. The method of claim 8, wherein the insulating layer includes a silicon oxide
5 layer.

10. The method of claim 8, wherein the thin film includes a silicon nitride layer.

11. The method of claim 8, wherein the thin film includes a polysilicon layer.

12. The method of claim 8, wherein the screen layer includes a spin-on-glass
layer.

13. The method of claim 8, wherein the screen layer includes a photoresist layer.

14. A method for forming a shallow trench isolation structure, applicable to a
substrate having at least an active area on the substrate, at least a trenches surrounding
the active area, and a pad oxide layer and a mask layer formed sequentially on the
substrate in the active area, the method comprising:

20 forming an insulation layer in the trenches and on the mask layer, wherein the
insulation layer in the trench has a thickness ranged between a sum of a depth of the
trench and a thickness of the pad oxide and a sum of the depth of the trench plus a
thickness of both the mask layer and the pad oxide layer;

forming a thin layer on the insulation layer;

forming a screen layer on the thin layer above the trenches;
removing the thin layer above the mask layer and above the active area, while
the screen layer and the thin layer above the trenches are not removed;
removing the insulating layer above the mask layer and above the active area;
5 removing the screen layer above the trenches;
removing the thin layer above the trenches; and
removing the mask layer above the active areas.

15. The method of claim 14, wherein the insulating layer includes a silicon oxide

10 layer.

16. The method of claim 14, wherein the thin layer includes a silicon nitride
layer.

15 17. The method of claim 14, wherein the thin layer includes a polysilicon layer.

18. The method of claim 14, wherein the screen layer includes a spin-on-glass
layer.

20 19. The method of claim 14, wherein the screen layer includes a photoresist
layer.

John J. T.
20. The method of claim 14, wherein the insulation layer is formed with a
vertical sidewall by controlling an etching/deposition ratio of a high density plasma
CVD step.

chemical vapor deposition step.